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SCIENTIFIC RESEARCH BY THE PUBLIC HEALTH SERVICE

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The increasing complexity of modern society gives rise continually to new sanitary problems which must be solved and the results applied if we would escape race deterioration and loss of industrial prosperity. Under present conditions the individual is himself unable to exercise all these measures of protection. Public health administration is therefore necessary, and one of its important functions is scientific research.

Governmental activities in the field of preventive medicine have accordingly included systematic investigations, practically all modern governments having made more or less provision for them, depending on the special problems presented for solution. A comparative statement of such provisions in the several countries and their influence on the public health would be of interest, and in the United States would necessarily include those of the federal, state, and municipal governments. It is practicable here to describe only the activities of the Federal Public Health Service, which service, however, is but a part of the public health organization of the country; the state and municipal health agencies being also included, and all being related by law and by reason of their common object.

While the triple relation mentioned has probably resulted in the past in a distribution of scientific effort and consequently limited centralization, on the whole it has been responsible for an immense amount of work of the greatest importance, and it is a striking fact that in addition to the several public health laboratories of the federal government there is authority in law for laboratories in no less than twenty states.

The present official interpretation put upon the constitution prevents the federal government from exercising police powers with

respect to sanitation within the states themselves. This restriction, consequently, modifies to some extent the character of the investigations by the Federal Public Health Service; but does not limit their scope, which embraces laboratory studies of all matters pertaining to the public health and the dissemination of the information thus acquired.

Organized originally to provide care and treatment for sick and injured sailors of the merchant marine, the Public Health Service has had a steady growth, having from time to time been charged with additional duties and granted greater powers. These additional duties included the prevention of the introduction of contagious and infectious diseases and their spread from one state to another, the medical inspection of arriving aliens, the supervision over the propagation and sale of viruses, serums and toxins, and in connection with all of them there was necessity of scientific investigations.

The Hygienic Laboratory

The activities in the field of scientific research may accordingly be said to have originated when these additional duties were assumed, and to have taken definite shape with the establishment of the hygienic laboratory at the Marine Hospital, New York, in 1887. Their inception therefore was practically coincident with the beginning of the growth of the science of bacteriology, which may be said to mark the start of the present public health movement that has now assumed world-wide proportions. It soon became evident that the foundations of public health research should be laid at the seat of government, and the laboratory was accordingly moved to Washington in 1891.

Since the quarantine act of February 15, 1893, imposed on the service the devising of regulations and their enforcement, for the prevention of the introduction of infectious and contagious diseases, and since the etiology, methods of transmission and prevention of some of those diseases was then but indefinitely understood, there was necessity of special studies of those subjects. In the early nineties, therefore, increasing attention was paid to the developing science of bacteriology and its bearing on preventive medicine. Officers attached to the Hygienic Laboratory were sent

abroad to acquaint them with the methods employed in foreign laboratories and the progress made. By this means, for instance, knowledge was had of the methods of propagating an immunizing serum for use in the treatment and prevention of diphtheria, and as a result diphtheria antitoxin was first made in the United States in the Hygienic Laboratory in November, 1894.

Studies were likewise made of disinfectants to determine their germicidal value and best methods of application, and for the generation of sulphur dioxide, furnaces were devised which, with but slight improvement, are now in use at the national quarantine stations. An autoclave for the evolution of formaldehyde gas was also invented and the best method of using it determined. These and many other practical discoveries indicate that substantial progress was made, and that the Hygienic Laboratory was developing into an important center for research in public health problems.

In the meantime important scientific studies were also being made by officers in the field, particularly in connection with epidemic work; those of Carter on the period of incubation of yellow fever having had a most important bearing on the subsequent investigations of that disease. In fact, his recorded observations on this point were hardly less important than Finlay's hypothesis in laying the foundation for success in the final demonstration of the transmission of yellow fever.

The outbreak of plague in Hongkong in 1894, which proved to be the beginning of the present pandemic of the disease, also stimulated research as to its nature and methods of prevention. There was therefore prepared in the Hygienic Laboratory, at the proper time, large quantities of the prophylactic vaccine for distribution in case the disease should be introduced, and bulletins containing the latest knowledge regarding plague were distributed for the information of public health officials and the public generally. By these means officers of the service became familiar with plague and were thus qualified to undertake quarantine duty at both domestic and foreign ports, and when the disease actually gained a foothold on the Pacific Coast they were prepared to recognize and combat it.

Prior to 1902 the Hygienic Laboratory had been devoted almost entirely to research in pathology and bacteriology, but a lab-

oratory building had been authorized by Congress in March of the preceding year, and it became evident that in order to discharge the functions for which it was created, and which were demanded in the public interest, there should be some enlargement of scope and reorganization on broader lines.

In accordance with an act of Congress of July 1, 1902, reorganizing the service, therefore, there were created three new divisions, which made in all four divisions of the Hygienic Laboratory, designated respectively as: pathology and bacteriology, medical zoology, pharmacology and chemistry. This act also provided for an advisory board of nine members, four of whom are officers of the government, and the remaining five eminent in their respective fields and connected with private educational institutions. By this means the laboratory is brought in touch with like institutions and the surgeon-general can secure advice with respect to the investigations to be made and the methods of making them.

It had long been the practice to make record in the annual reports of the work accomplished, or in the public health reports which have been published weekly since 1885, and in some instances special brochures were issued independent of these publications. But with the reorganization of the service in 1902 it was apparent that the results of investigations, in order to be of the most benefit, should be published as Hygienic Laboratory Bulletins. Since that time seventy-three such bulletins have been issued, their titles being as follows:

Preliminary Note on the Viability of the *Bacillus pestis*.

Formalin Disinfection of Baggage without Apparatus.

Sulphur Dioxid as a Germicidal Agent.

Viability of the *Bacillus pestis*.

An Investigation of Pathogenic Microbe (*B. typhi murium* Danyz) Applied to the Destruction of Rats.

Disinfection against Mosquitoes with Formaldehyde and Sulphur Dioxid.

Laboratory Technique: Ring Test for Indol; Collodium Sacs; Microphotography with Simple Apparatus.

Laboratory Course in Pathology and Bacteriology.

Presence of Tetanus in Commercial Gelatin.

Report upon the Prevalence and Geographic Distribution of Hookworm Disease (Uncinariasis or Anchylostomiasis) in the United States.

An Experimental Investigation of *Trypanosoma lewisi*.

The Bacteriological Impurities of Vaccine Virus; an Experimental Study.

A Statistical Study of the Intestinal Parasites of 500 White Male Patients at the United States Government Hospital for the Insane. A Parasitic Roundworm (*Agamomermis culicis* n.g., n.sp.) in American Mosquitoes (*Culex sollicitans*). The Type Species of the Cestode Genus *Hymenolepis*.

Spotted Fever (Tick Fever) of the Rocky Mountains; a New Disease. Inefficiency of Ferrous Sulphate as an Antiseptic and Germicide.

The Antiseptic and Germicidal Properties of Glycerin.

Illustrated Key to the Trematode Parasites of Man.

An Account of the Tapeworms of the Genus *Hymenolepis* Parasitic in Man, Including Reports of Several New Cases of the Dwarf Tapeworm (*H. nana*) in the United States.

A Method of Inoculating Animals with Precise Amounts.

A Zoological Investigation into the Cause, Transmission and Source of Rocky Mountain "Spotted Fever."

The Immunity Unit for Standardizing Diphtheria Antitoxin (Based on Ehrlich's Normal Serum). Official Standard Prepared under the Act Approved July 1, 1902.

Chloride of Zinc as a Deodorant, Antiseptic, and Germicide.

Changes in the Pharmacopoeia of the United States of America.

The International Code of Zoological Nomenclature as Applied to Medicine.

Illustrated Key to the Cestode Parasites of Man.

On the Stability of the Oxidases and their Conduct toward Various Reagents. The Conduct of Phenolphthalein in the Animal Organism. A Test for Saccharin, and a Simple Method of Distinguishing between Cumarin and Vanillin. The Toxicity of Ozone and Other Oxidizing Agents to Lipase. The Influence of Chemical Constitution on the Lipolytic Hydrolysis of Ethereal Salts.

The Limitations of Formaldehyde Gas as a Disinfectant with Special Reference to Car Sanitation.

A Statistical Study of the Prevalence of Intestinal Worms in Man.

A Study of the Cause of Sudden Death Following the Injection of Horse Serum.

I. Maternal Transmission of Immunity to Diphtheria Toxine. II. Maternal Transmission of Immunity to Diphtheria Toxine and Hypersusceptibility to Horse Serum in the Same Animal.

Variations in the Peroxidase Activity of the Blood in Health and Disease.

A Stomach Lesion in Guinea Pigs Caused by Diphtheria Toxine and Its Bearing upon Experimental Gastric Ulcer.

Studies in Experimental Alcoholism.

I. *Agamofilaria georgiana* n.sp., an Apparently New Roundworm from the Ankle of a Negress. II. The Zoological Characters of the Roundworm Genus *Filaria* Mueller, 1787. III. Three New American Cases of Infection of Man with Horsehair Worms (Species *Pagordius varius*), with Summary of All Cases Reported to Date.

Report of the Origin and Prevalence of Typhoid Fever in the District of Columbia.

Further Studies upon Hypersusceptibility and Immunity.

Index-Catalogue of Medical and Veterinary Zoology. Subjects: Trematoda and Trematode Diseases.

The Influence of Antitoxin upon Post-diphtheritic Paralysis.

The Antiseptic and Germicidal Properties of Solutions of Formaldehyde and their Action upon Toxines.

1. The Occurrence of a Proliferating Cestode Larva (*Sparganum proliferum*) in Man in Florida. 2. A Re-examination of the Type Specimen of *Filaria restiformis*. 3. Observations of Two New Parasitic Trematode Worms: *Homalogaster philippinensis* n.sp., *Agamodistum nanus*. A Re-examination of the Original Specimen of *Taenia saginata abietina* (Weinland, 1858).

Milk and its Relation to the Public Health.

The Thermal Death Points of Pathogenic Micro-organisms in Milk.

The Standardization of Tetanus Antitoxin (an American Unit Established under Authority of the Act of July 1, 1902).

Report No. 2 on the Origin and Prevalence of Typhoid Fever in the District of Columbia.

Further Studies upon Anaphylaxis.

Hepatizon perniciosum (n.g., n.sp.); a Haemogregarine Pathogenic for White Rats; with a Description of the Sexual Cycle in the Intermediate Host, a Mite.

Studies on Thyroid: I. The Relation of Iodine to the Physiological Activity of Thyroid Preparations.

The Physiological Standardization of Digitalis.

Digest of Comments on the United States Pharmacopoeia. Eighth Decennial Revision for the Period Ending December 31, 1905.

Further Studies upon the Phenomenon of Anaphylaxis.

Chemical Tests for Blood.

Report No. 3 on the Origin and Prevalence of Typhoid Fever in the District of Columbia.

The Influence of Certain Drugs upon the Toxicity of Acetanilide and Antipyrine.

The Fixing Power of Alkaloids on Volatile Acids and its Application to the Estimation of Alkaloids with the Aid of Phenolphthalein or by the Vollhard Method.

Quantitative Pharmacological Studies: Adrenalin and Adrenalin-like Bodies.

Milk and Its Relation to the Public Health.

I. The Presence of Tubercle Bacilli in the Circulating Blood in Clinical and Experimental Tuberculosis. II. The Viability of the Tubercle Bacillus.

Digest of Comments on the Pharmacopoeia of the United States of America (Eighth Decennial Revision) and the National Formulary for the Period Ending December 31, 1906.

The Oxidases and Other Oxygen Catalysts Concerned in Biological Oxidations.

A Study of the Anatomy of *Watsonius* (n.g.) *Watsoni* of Man, and of 19 Allied Species of Mammalian Trematode Worms of the Superfamily *Paramphistomoidea*.

Quantitative Pharmacological Studies: Relative Physiological Activity of Some Commercial Solutions of Epinephrin.

The Taxonomic Value of the Microscopic Structure of the Stigmal Plates in the Tick Genus *Dermacentor*.

Digest of Comments on the Pharmacopoeia of the United States of America (Eighth Decennial Revision) and the National Formulary (Third Edition) for the Calendar Year Ending December 31, 1907.

Studies upon Anaphylaxis with Special Reference to the Antibodies Concerned.

Facts and Problems of Rabies.

I. The Influence of Age and Temperature on the Potency of Diphtheria Antitoxin. II. An Organism (*Pseudomonas protea*) Isolated from Water, Agglutinated by the Serum of Typhoid Fever Patients. III. Some Considerations on Colorimetry, and a New Colorimeter. IV. A Gas Generator, in Four Forms, for Laboratory and Technical Use.

The Solubilities of the Pharmacopoeial Organic Acids and their Salts.

The Bleaching of Flour and the Effect of Nitrites on Certain Medicinal Substances.

The Effect of a Restricted Diet and of Various Diets upon the Resistance of Animals to Certain Poisons.

A Study of Melting Point Determinations with Special Reference to the Melting Point Requirements of the United States Pharmacopoeia.

I. Some Known and Three New Endoparasitic Trematodes from American Fresh Water Fish. II. On Some New Parasitic Trematode Worms of the Genus *Telorchis*. III. A New Species of *Athesmia* from a Monkey.

I. Report of an Outbreak of Typhoid Fever at Omaha, Neb. (1909-1910). II. The Water Supply of Williamson, W. Va., and its Relation to an Epidemic of Typhoid Fever.

The Effects of a Number of Derivatives of Choline and Analogous Compounds on the Blood-Pressure.

These bulletins represent very well the scope and activities of the Hygienic Laboratory in relation to scientific research. But in addition there have been published in the medical and scientific literature, or placed on file in the archives of the bureau, many brief reports and papers that have had a distinct value in the advancement of public health administration.

The Hygienic Laboratory has also been utilized as a school of instruction for officers of the Public Health Service, and its facilities have been extended from time to time to sanitary officers on

request of state health authorities. By this means the sanitary corps has been strengthened, and from among its members have been developed those capable of conducting independent research. By this means also it was possible to inaugurate scientific investigations in connection with public health stations already established.

Severe outbreaks of the great epidemic diseases have been indications for the conduct of research of a clinical or laboratory nature in the infected localities. By this means special studies of smallpox were made on the Mexican frontier in 1895; yellow fever was studied in the Southern States, and plague in Honolulu, T. H.; Seattle, Wash., and San Francisco, Oakland, and Los Angeles, Cal.

The Federal Laboratory of the Pacific

The suppression of plague in a community is closely associated with the eradication of the disease among rodents. In order, therefore, to determine the extent of the epizootic among these animals daily examinations of large numbers are necessary, and there has also been need of careful studies to clear away the mysteries surrounding the relationship of the disease in man and animals.

The Federal Plague Laboratory was therefore established during the first plague outbreak in San Francisco, and has been an important agent in the suppression of the first and second outbreaks of the disease. Its most lasting value, however, will be derived from the scientific studies conducted therein regarding the epidemiology of plague among ground squirrels and other rodents. Some of the published reports of these studies are as follows:

Plague Infection in Rats.

Organic Diseases of the Rat.

Rodents in Relation to the Transmission of Bubonic Plague.

Rodent Extermination; Rats and Mice.

Rat-Proofing as an Antiplague Measure.

Notes on Rat Leprosy and on the Fate of Human and Rat *Lepra Bacilli* in Flies.

Experimental Investigation of Biting of Man by Fleas from Rats and Squirrels.

Evidence of Plague Infection among Ground Squirrels.

General Observations on the Bionomics of the Rodent and Human Fleas.

As an additional means of disseminating information regarding the pathology and diagnosis of plague in rodents, mounted speci-

mens of plague tissues were prepared and furnished to over one hundred and fifty medical colleges and models illustrating various phases of the disease made and exhibited to the public.

In the Federal Laboratory on the Pacific careful observations have been made not only of plague lesions, but other abnormalities among rodents, particularly lawless growths. The exact value of this work can not yet be estimated, but in view of the stimulus given to the study of cancer by the recent successful transplantation of tumors, it is possible that careful observations of these abnormalities may in time develop additional facts that will have some bearing on the cancer problem. At any rate, it was through such observations that a leprosy-like disease of rats was first detected on the Pacific Coast, which observation is of particular interest to those engaged in the study of leprosy in man.

While the above-mentioned laboratory was established only in response to a great administrative necessity, and therefore limited in its scope, there are cogent reasons why it should be enlarged and devoted to the solution of the sanitary problems peculiar to the Pacific Coast. One of these is the necessity of epidemiological studies of leprosy and certain diseases peculiar to the Orient.

The Leprosy Investigation Station

A commission was appointed in 1899 in accordance with a provision of an act of Congress to study leprosy, particularly with reference to its prevalence in the United States. These studies developed the fact that there were no less than two hundred and eighteen cases of leprosy located in twenty-one states at the time the report of the commission was made in 1902, and indicated that some provision should be made for the national care of lepers. More important still, it indicated that there should be systematic studies of leprosy with the view to determining the methods of transmission of the disease and the improved methods of treatment.

Congress accordingly provided for such investigations in Hawaii, and appropriated funds for the establishment of a leprosy investigation station on the island of Molokai. Systematic studies were begun in 1906, and the results are recorded in thirteen papers. The titles of these papers are as follows:

The Present Status of the Leprosy Problem in Hawaii.

The Reaction of Lepers to Moro's "Percutaneous" Test.

A Note Upon the Possibility of the Mosquito Acting in the Transmission of Leprosy.

Upon the Utility of the Examination of the Nose and the Nasal Secretions for the Detection of Incipient Cases of Leprosy.

A Report upon the Treatment of Six Cases of Leprosy with Nastine (Deycke).

Leprosy in the United States of America in 1909.

A Statistical Study of an Endemic Focus of Leprosy.

A Palliative Treatment for Leprous Rhinitis.

Mosquitoes in Relation to the Transmission of Leprosy.

Flies in Relation to the Transmission of Leprosy.

Heredity versus Environment in Leprosy.

Notes on the Study of Histories of Lepers from the Standpoint of Transmission.

A Contribution to the Study of Rat Leprosy.

Early in the work it was recognized that the solution of the leprosy problem was to be sought for among incipient cases and in the homes of the lepers themselves. A branch laboratory was accordingly established at the Kalihi Station on Oahu, where lepers are brought on being apprehended, and here work of the most important character is being prosecuted. While it is inadvisable to anticipate the results of these studies before publication, it is pertinent to refer to the successful growth of the leprosy bacillus, and the important bearing this achievement will have on the subsequent steps of the investigation. In fact the way is now open for the production of a therapeutic vaccine and perhaps an antitoxic serum.

The Laboratories of Marine Hospitals and Quarantine Stations

Besides the above laboratories devoted wholly to research, provision is made at certain of the marine hospitals and quarantine stations for making public health investigations. At the quarantine stations such studies have mostly to do with determining the best means of disinfection and perfecting methods for their application. In addition, extended experiments have been made of the life history of mosquitoes, the culicidal properties of gases and other subjects specially related to quarantine practice.

At the marine hospitals there is always opportunity for clinical research, and in some instances this is unexcelled because of the character of the patients admitted and the fact that they come from

every quarter of the globe. In addition these stations are utilized as public health stations where certain experiments can be long continued. For instance, at the marine hospital at Wilmington, N. C., investigations are now being made of soil pollution and the best methods for its prevention; a question the solution of which must have an important bearing on the improvement of rural sanitation. Because of their location, and relation to the public health service, these stations are capable of becoming the recognized centers of special research, and with adequate authority to admit for purposes of scientific studies cases of diseases affecting the public health there would be provided a powerful means of determining the causes, methods of transmission and prevention of such diseases within the country.

The field for research is broad, but in view of present limitations as to funds, the investigations to be undertaken must be carefully planned and the work directed in order that there shall not be duplication or loss of energy. It was accordingly recognized that a central office was necessary that would keep in touch with the scientific workers and relieve them of certain administrative obligations. This was accomplished through the establishment of a bureau division of scientific research.

Supervision of Viruses, Serums and Toxins

With the reorganization of the Marine Hospital Service into a Bureau of Public Health in 1902, a division of scientific research was provided, through which are handled the administrative matters connected with service investigations.

Special work of a statistical character is also carried on and the results published from time to time in the form of Public Health Bulletins.

It is the additional duty of this division to supervise the publication of all scientific reports, except the "Public Health Reports," and to discharge those administrative duties connected with the enforcement of the law of July 1, 1902, regulating the propagation of viruses, serums and toxins in interstate traffic. This law requires that all viruses, serums and toxins offered for sale in interstate traffic shall be propagated and prepared only in establishments licensed by the Secretary of the Treasury. Licenses are granted

only after inspection of establishments made in accordance with regulations issued under the law, and examination in the Hygienic Laboratory of products for which license is desired. Since these biologic products are intended for hypodermatic injections, their freedom from contamination is of paramount importance, and because of the great value of some of them in the treatment of the diseases for which they are intended, it is essential that purity and potency should be assured. The adoption of standards, therefore, became necessary. Standards for testing the strength of diphtheria antitoxin and tetanus antitoxin were especially needed, and investigations to this end were undertaken and continued until a standard for diphtheria antitoxin was adopted in 1905, and a standard for tetanus antitoxin devised in 1906. The standard units are prepared in the Hygienic Laboratory and distributed bi-monthly to all licensed manufacturers and others concerned, and, by means of examinations of serums on the market from time to time, it is determined whether they are free from contamination and conform to these standards, and in the case of those products for which no standard has been devised, whether contamination is present or not. It is evident that the administration of the law regulating the propagation of biologic products involves a large amount of highly technical work and requires investigations in the broad field of immunity. As a result studies of anaphylaxis in relation to immunity have been continued over a period of more than four years and stimulated an immense amount of work on the same problem in other laboratories throughout the world. The number of biologic preparations intended for the prevention and cure of diseases of man is rapidly increasing, and their standardization becomes a matter of importance. Investigations with this end in view therefore comprise one of the most important activities of the service at the present time.

An inquiry into the prevalence of rabies during 1908 and subsequent studies of antirabic virus led to the preparation of that product for administration at the Hygienic Laboratory and its distribution for the use of state health authorities. As a result, this treatment was made available to 1,143 patients from April 25, 1908, to June 30, 1910, and the problems of rabies are being carefully investigated.

Zoological Investigations

Beginning with the discovery of the *Uncinaria Americana* in 1902, studies of hookworm disease have been carried on with great energy, and in my opinion no other single event in the field of preventive medicine has had as far-reaching importance to the people of the United States since the discovery of diphtheria antitoxin. The studies already made have not only accounted for a large amount of invalidism in the South and cleared away in some measure the confusion with respect to several diseases, but they have demonstrated the methods necessary to the improvement of the physical and mental vigor of the people of an important section of the country. Zoological studies in the interest of the public health are especially indicated in view of the causal relation of animal parasites to diseases and the influence of insects as carriers of infection, and represent a broad field of activities of the Public Health Service. Studies of a number of subjects are now in progress, and the results of those completed are contained in bulletins already published.

Pharmacologic Research

Authority having been granted in 1901 for laboratory investigations of matters pertaining to the public health, and a division of pharmacology in the Hygienic Laboratory having been authorized in 1902, pharmacologic studies became a part of the activities of the service. Investigations of organo-therapeutic and other medicinal preparations were inaugurated and have been continued. Digests of comments on the Pharmacopoeia and the National Formulary are compiled regularly and published for use in connection with revision of those important official standards. The importance of establishing standards of strength for potent drugs has opened up a wide field for investigations; those already in progress relating to epinephrin, ergot and digitalis. In addition, new preparations are being made from time to time and studied as to their therapeutic value. These matters also involve physiologic consideration including the functions of the ductless gland.

Recent announcement of the discovery of an arsenic preparation reputed to have marvelous curative properties in certain protozoal diseases indicates the possibilities of pharmacologic studies,

and emphasizes the importance of their continuance under official auspices.

Chemical Studies

As previously stated, provision was made for a division of chemistry in the Hygienic Laboratory, wherein have been conducted systematic studies of water and milk in relation to the public health. The action of ferments and the chemistry of the blood have also been considered and the results published as bulletins. Other studies made and the bearing of chemical questions on the public health emphasize the scope of this division, which was but recently organized and which is destined to fulfil an important function in public health work.

Epidemiological Investigations

The foregoing organization for research and the facilities for carrying it on have resulted in the co-operation of several of the divisions along epidemiologic lines.

Typhoid fever has been the subject of continuous studies for over four and one-half years, and has engaged the attention at times of three of the divisions of the Hygienic Laboratory. Aside from tuberculosis there is no infectious disease that is more nearly universal in the United States, and none deserving more earnest study from both health and economic standpoints.

Systematic studies into the origin and prevalence of typhoid fever were begun in the District of Columbia in 1906, and carried on there during four seasons. A large amount of accurate data was accumulated and published, throwing light on the local problem and having general application to typhoid fever problems in other sections of the country. Studies of the disease have also been made by the service in five widely separated states; and the facts elicited while clearing up local problems have indicated the necessity of like studies in other sections of the country.

The manifold avenues through which typhoid fever spreads involves a wide field for investigations. The studies are necessarily made in the presence of outbreaks and include many lines, such as the purity of milk supplies, the extent of the pollution of water supplies, the rôle of insects as carriers of infection, the percentage of bacillus carriers among the population in different sections of the

country, and the influence of contact as a factor in the propagation of the disease.

A large amount of data is necessary on all phases of the typhoid fever problem in order that the deductions to be drawn may be of general application. There is also necessity for a better understanding on the part of the people as to the known facts regarding preventive measures, and this comprises one of the most important duties of the Public Health Service in relation to the control of the disease.

Similar statements apply also to other preventable diseases, such as pellagra and poliomyelitis, which are being made subjects of special study. There is authority for their investigation in the laboratory, and the extent of such activities is limited only by the available appropriations. Since, however, the prevention of diseases involves improved sanitary methods and devices, additional authority must be had for studies outside the Hygienic Laboratory better to cover the field.

From the brief outline presented it is apparent that the activities of the Public Health Service relate to many subjects, and that their enlargement, in so far as relates to research, is almost wholly dependent on additional authority to be obtained.

Because of our form of government and the consequent division of responsibility among national, state and municipal agencies in respect to the public health, two of the most important duties of the federal government are, in my opinion, scientific research and the collection and dissemination of useful information. The object of the present public health movement is to prevent disease and to prolong life and make it more productive. This can be accomplished largely through universal acceptance and observance of hygienic principles by the people.

Legal restrictions are necessary and there will undoubtedly be indication for others in the interest of the public health, but when adopted they will of necessity be enforced by the states, except in those instances involving interstate relations. But the federal government will perform an important service in bringing about uniformity of action by rendering accessible the facts on which such action is based.

In the German Empire a wise policy has had such an effect.

In that country the confederation of states and free cities is looser than in the United States; yet governmental scientific research in the interest of the public health has been most productive, and the large amount of valuable statistics available was collected through voluntary co-operation of those states and cities. Theoretically the imperial government can exercise police powers in a state for the suppression of outbreaks of disease, but so far as known this has not been done nor has there been any necessity for doing so. The experience of the German Empire is of value in considering the development of future public health activities in our country, especially as relates to scientific research. The organization for such work on the part of the federal government is well founded, and in certain respects broader than in other countries. With proper development it should in time be as productive of results as any national agency.